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Information technology — Automatic identification and data capture techniques — Real time locating systems (RTLS) device conformance test methods —

Part 5: Test methods for chirp spread spectrum (CSS) at 2,4 GHz air interface

Technologies de l'information — Techniques d'identification automatique et de capture de données — Systèmes de localisation en temps réel (RTLS) méthodologie des tests de conformité —

Partie 5: Méthodologie de test de l'interface d'air à 2,4 GHz avec étalement de spectre par compression d'impulsions (CSS)

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 24769-5 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

This corrected version of ISO/IEC 24769-5:2012 incorporates the following corrections:

— All references to ISO/IEC 24703-5 have been changed to ISO/IEC 24730-5.

ISO/IEC 24769 consists of the following parts, under the general title *Information technology, Automatic identification and data capture techniques — Real time locating systems (RTLS) device conformance test methods*:

— *Part 2: Test methods for air interface communication at 2,4 GHz*

— *Part 5: Test methods for chirp spread spectrum (CSS) at 2,4 GHz air interface*

Introduction

ISO/IEC 24730 defines air interface protocols and an Application Program Interface (API) for Real Time Locating Systems (RTLS).

ISO/IEC 24730-5 defines an air interface which utilizes Chirp Spread Spectrum (CSS) at frequencies from 2.4-2.483 GHz. Chirp pulses, which are pulses with a fast increasing or decreasing instantaneous frequency, have originally used for radar applications. Lately, chirp pulses have been also used for communication applications.

ISO/IEC 24730-5 includes ranging and bidirectional communication between tags and infrastructures. Bidirectional communication enables the infrastructure to control the behaviour of tags.

The purpose of ISO/IEC TR 24769-5 is to provide tests conditions and methods for conformance to ISO/IEC 24730-5.

ISO/IEC TR 24769-5 contains all measurements required to be made on a product in order to establish whether it conforms to ISO/IEC 24730-5.

Information technology — Automatic identification and data capture techniques — Real time locating systems (RTLS) device conformance test methods —

Part 5:
Test methods for chirp spread spectrum (CSS) at 2,4 GHz air interface

1 Scope

This part of ISO/IEC 24769 defines the test methods for determining the conformance of real time locating systems (RTLS) tags and readers with the specifications given in the corresponding parts of ISO/IEC 24730-5.

This part of ISO/IEC 24769 does not include the testing of conformity with regulatory requirements.

The test methods require only that the mandatory functions, and any optional functions which are implemented, be verified

The conformance parameters described in this part of ISO/IEC 24769 include the radio frequency air interface and packet exchange required to perform the locating of the RTLS tag. It includes the mandatory 2-ary orthogonal chirp spread spectrum (CSS) modulation and the optional differential quadrature phase shift keying (DQPSK) CSS. This part of ISO/IEC 24769 also includes the ranging packet exchanges, the commands and the reports defined in ISO/IEC 24730-5.

Unless otherwise specified, the tests in this part of ISO/IEC 24769 shall be applied exclusively to RTLS tags and readers defined in ISO/IEC 24730-5.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 19762-1: *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary — Part 1: General terms relating to AIDC*

ISO/IEC 19762-3: *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary — Part 3: Radio-Frequency Identification (RFID)*

ISO/IEC 19762-4: *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary — Part 4: General terms relating to radio communications*

ISO/IEC 19762-5: *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary — Part 5: Locating systems*

ISO/IEC 24730-5: *Information technology — Real Time Locating Systems (RTLS) — Part 5: Chirp Spread Spectrum (CSS) at 2.4 GHz air interface*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19762-1, ISO/IEC 19762-3, ISO/IEC 19762-4, ISO/IEC 19762-5 and the following apply.

3.1
Chirp Spread Spectrum
technique for spreading the bandwidth of a digital signal using linear frequency sweep signals

3.2
Class I
system that operates at a radiated power up to 10 mW EIRP

3.3
Class II
system that operates at a radiated power higher than 10 mW up to the maximum defined by local regulations

3.4
Ranging
process of determining the distance between two RTLS transceivers through the exchange of a specific set of messages

3.4
Ranging peer
RTLS transceiver to perform ranging with

3.5
RTLS tag
RTLS transceiver that accepts commands from RTLS readers, sends blinks and reports to the RTLS readers

4 Symbols and abbreviated terms

API	Application Program Interface
AWG	Arbitrary Waveform Generator
CRC	Cyclic Redundancy Check
CSMA/CA	Carrier Sense Multiple Access / Collision Avoid
CSS	Chirp Spread Spectrum
DQPSK	Differential Quadrature Phase Shift Keying
DUT	Device Under Test
EIRP	Effective Isotropic Radiated Power
MAC	Medium Access Control
PPM	Parts Per Million
RTLS	Real Time Locating System
SG	Signal Generator

Src	Source address
T_{RXON}	Duration of time interval during which the receiver is activated
T1R1	Application ranging packet type 1 of the ranging packet exchange type 1

5 Conformance tests for ISO/IEC 24730-5

5.1 General

This technical report specifies a series of tests to determine the conformance of RTLS tags and readers to the ISO/IEC 24730-5 air interface and packet exchanges required to be performed between tags and infrastructures in order to control and retrieve information about location and states of tags.

5.2 Overall Test conditions

Unless otherwise specified, these test conditions apply to all tests in this part of ISO/IEC 24769.

5.2.1 Test environment

Unless otherwise specified, testing shall take place in an environment of temperature 23° C ± 3 °C and of relative humidity 25 % to 75 %.

5.2.2 Default tolerance

Unless otherwise specified, a default tolerance of ± 5% shall be applied to the quantity values given to specify the characteristics of the test equipment and the test method procedures.

5.3 Transmitter and Receiver setup

In order to perform some test cases, one or several specific setups will be required to either transmit packets or to receive and decode packets according to the ISO/IEC 24730-5 standard. These setups are described hereafter.

5.3.1 Transmitting setup

The transmitting setup shall be used to validate the reception performances of the DUT and to verify the compliance of the DUT to the tag application layer by transmitting various commands.

In order to transmit data according to the specification of ISO/IEC 24730-5, the following parts are required:

— Control Application: An application which controls the signal generator in order to perform the tasks required by this part of ISO/IEC 24769.

— Arbitrary Waveform Generator: for example, a Tektronix AWG2041 or equivalent, as described in Annex A.

— Signal Generator: for example, an Agilent ESG E4438C or equivalent, as described in Annex A. If the AWG is able to deliver the proper signal at the desired frequency, the SG might not be necessary.

— Frequency Mixer: for example, a Mini-Circuits ZEM-4300+ or equivalent.

Figure 1 below shows the required transmitting setup:

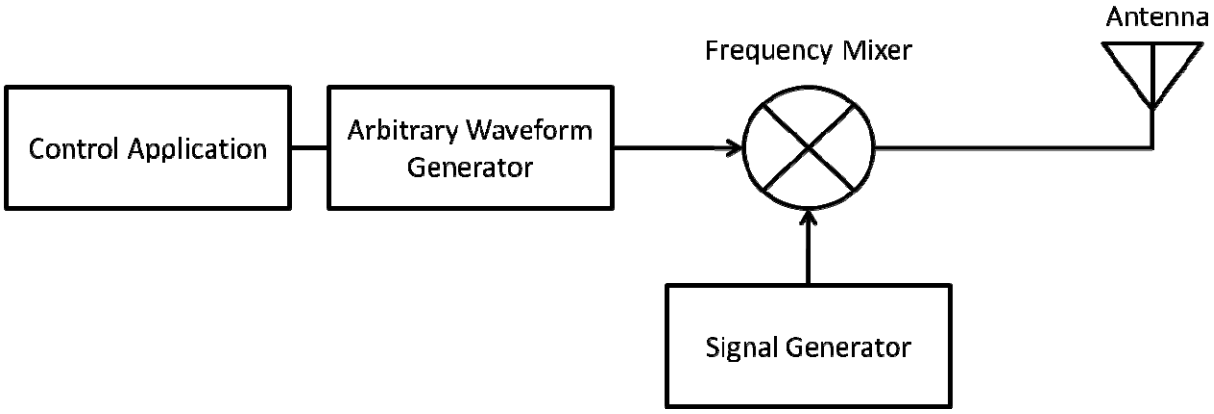

Figure 1 — Transmitting setup

5.3.2 Receiving setup

The receiving setup shall be used to validate the data transmitted by the DUT and to verify the compliance of the DUT to the tag application layer.

In order to receive and decode data according to the specification of ISO/IEC 24730-5, the following parts are required:

— Frequency Mixer: for example, a Mini-Circuits ZEM-4300+ or equivalent.

— Signal Generator: for example, an Agilent ESG E4438C or equivalent, as described in Annex A.

— Oscilloscope: for example, a Tektronix DPO 7104 or equivalent, as described in Annex A.

— Post processing application: An application which controls the oscilloscope in order to gather the data required to validate if the DUT is compliant with the test specification.

Figure 2 below shows the required receiving setup:

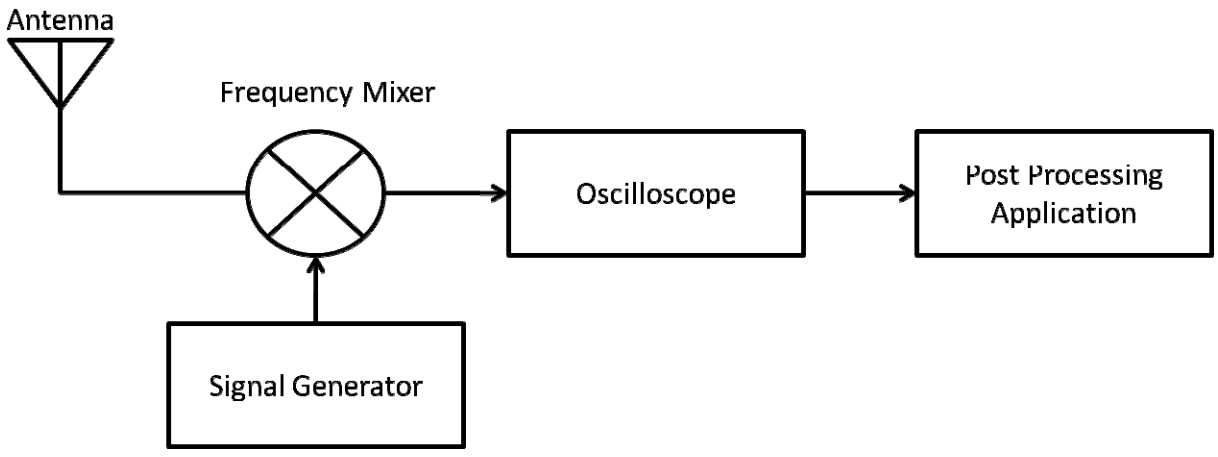

Figure 2 — Receiving setup

5.4 RF transmission tests

This describes the conditions and tests to validate the radio frequency transmission.

5.4.1 Test setup

The device under test (DUT) shall be a RTLS tag or reader. The measurement equipment shall consist of an anechoic chamber, one or several measuring antennas, a spectrum analyzer, an oscilloscope and a receiving setup.

Technical requirements of the spectrum analyzer, for example, an Agilent E4443A or equivalent, are described in Annex A.

The DUT shall be placed at a distance between 1 meter and 3 meters from the measurement antenna.

Figure 3 below shows the required test setup:

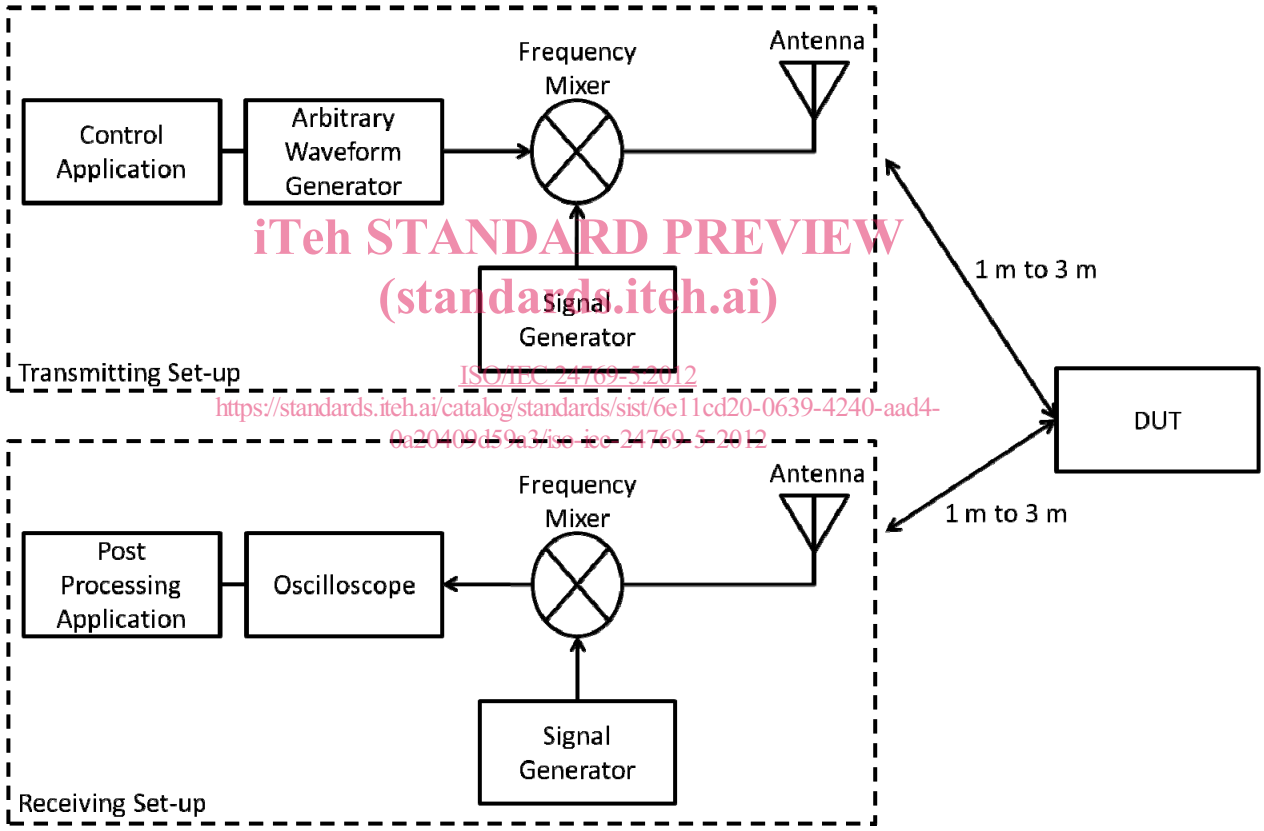

Figure 3 — RF transmission test setup

All measurement shall be done with a video and resolution bandwidth of minimum 100 KHz.

5.4.2 2-ary orthogonal CSS modulation at 1 Mbits/s transmission test

5.4.2.1 Test objective

The objective of this test is to validate that the DUT provides the appropriate 2-ary orthogonal CSS modulation waveform and data rate defined in ISO/IEC 24730-5 and required for proper system performance.

5.4.2.2 Test conditions

The test setup shall be according to 5.4.1.

The DUT shall be configured with the following configuration:

— Transmit on channel 0 with a centre frequency of 2441.75 MHz (as defined in Table 2 in 7.3 of ISO/IEC 24730-5).

— Occupied channel bandwidth: 80 MHz.

— Data bit rates: 1 Mbits/s.

— Modulation: 2-ary orthogonal CSS.

— Transmit power shall be at a class 1 power between 0 dBm and +10 dBm EIRP.

— Media access: ALOHA (as defined in 8.5.4 of ISO/IEC 24730-5) which correspond to CSMA/CA off (as defined in Table 27 in 9.3.2 of ISO/IEC 24730-5).

— Transmit a blink packet (as defined in 9.4.1 of ISO/IEC 24730-5) every 1 second. As a blink packet can include user defined data, the length is not fixed but should be kept below 64 bytes in total. The total packet length shall be specified by the manufacturer of the DUT.

5.4.2.3 Test measurements and requirements

The person in charge of the test, or the test application, shall be able to validate the parameters described hereafter.

5.4.2.3.1 Carrier frequency

The carrier frequency shall be measured with the spectrum analyzer.

The carrier frequency shall be 2441.750 MHz ± 171 KHz (70 PPM). The carrier frequency drift over the duration of the entire message shall be less than 12 KHz (5 PPM).

5.4.2.3.2 Occupied channel bandwidth

The 20 dB occupied bandwidth shall be measured with the spectrum analyzer.

The 20 dB occupied bandwidth shall be below 83.5 MHz. (As specified in Figure 5 in 7.3.2 of ISO/IEC 24730-5)

5.4.2.3.3 Transmit power

The power received shall be measured with the spectrum analyzer.

The transmitted power shall be calculated based on the power received at the measurement antenna. The calculated power shall be within ± 2.0 dB of the DUT specified transmitting power.

5.4.2.3.4 Symbol rate

The symbol rate shall be measured with the oscilloscope. The signal can be down converted in order to increase the accuracy of the measurement.

The symbol rate of the 2-ary orthogonal CSS shall be 10^6 symbols per second ± 70 symbols (70 PPM).